KTL Ottawa

Safety - EMI - Telecom - ISO Guide 25

ENGINEERING TEST REPORT

ON:
"INET 4 WATT BOOSTER FOR SPIDER B3 PCMCIA CDPD MODEM"

FCC ID: MIVWG9703A

IN ACCORDANCE WITH:
FCC PART 22, SUBPART H
CELLULAR BAND REPEATERS

PROJECT NO.: 8R00203

TESTED FOR:

INET INC.
1255 W. 15TH STREET
PLANO, TEXAS
75075-7270

TESTED BY:

KTL OTTAWA INC.
3325 RIVER ROAD, R.R. 5
OTTAWA, ONTARIO K1V 1H2

NVLAP LAB CODE: 100351-0

JUNE 1998

This document contains 38 pages including this one.

MODEL NO.: Spider B3

SERIAL NO.: None

GENERAL:

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 22, Subpart H.

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See "Summary of Test Data".

TESTED BY: _____ DATE: _____
Tom Tidwell, Senior Technologist

APPROVED BY: _____ DATE: _____
W. Waterhouse, RF Engineering Lab Manager

SUMMARY OF TEST DATA

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	22.913(a)	500W ERP	4.5W	Complies
Audio Frequency Response	22.915(d)	6dB/octave	N/A	N/A
Audio Low-Pass Filter Response	2.987(a)		N/A	N/A
Modulation Limiting	22.915(b)	12 kHz	N/A	N/A
Occupied Bandwidth(Voice)	22.917(c)	Mask A	N/A	N/A
Occupied Bandwidth(Voice + SAT)	22.917(c)	Mask C	N/A	N/A
Occupied Bandwidth(CDPD)	22.917(d)	Mask D	Plots	Complies
Occupied Bandwidth(Alternate Mod.)	NONE	NONE	N/A	N/A
Spurious Emissions at Antenna Terminals	22.917	-13 dBm	-21 dBm	Complies
Field Strength of Spurious Emissions	22.917	-13 dBm E.I.R.P.	-19.4 dBm	Complies
Frequency Stability	22.355	1.5 ppm	N/A	N/A

FOOTNOTES FOR N/A'S:

The E.U.T. does not contain modulation circuitry or frequency stability circuitry.

GENERAL EQUIPMENT SPECIFICATION

TRANSMITTER

Frequency Range:	869 - 894 MHz
Tunable Bands:	1
Necessary Bandwidth:	Not Applicable
Type of Modulation:	Not Applicable
Internal/External Data Source:	Not Applicable
Emission Designator:	FXW (CDPD)
Output Impedance:	50 ohms
RF Power Output (rated):	Single: 4 W Composite: Not Applicable
Number of Channels:	Not Applicable
Duty Cycle:	Continuous
Channel Spacing:	Not Applicable
Operator Selection of Operating Frequency:	Software controlled
Power Output Adjustment Capability:	Software controlled

GENERAL EQUIPMENT SPECIFICATION

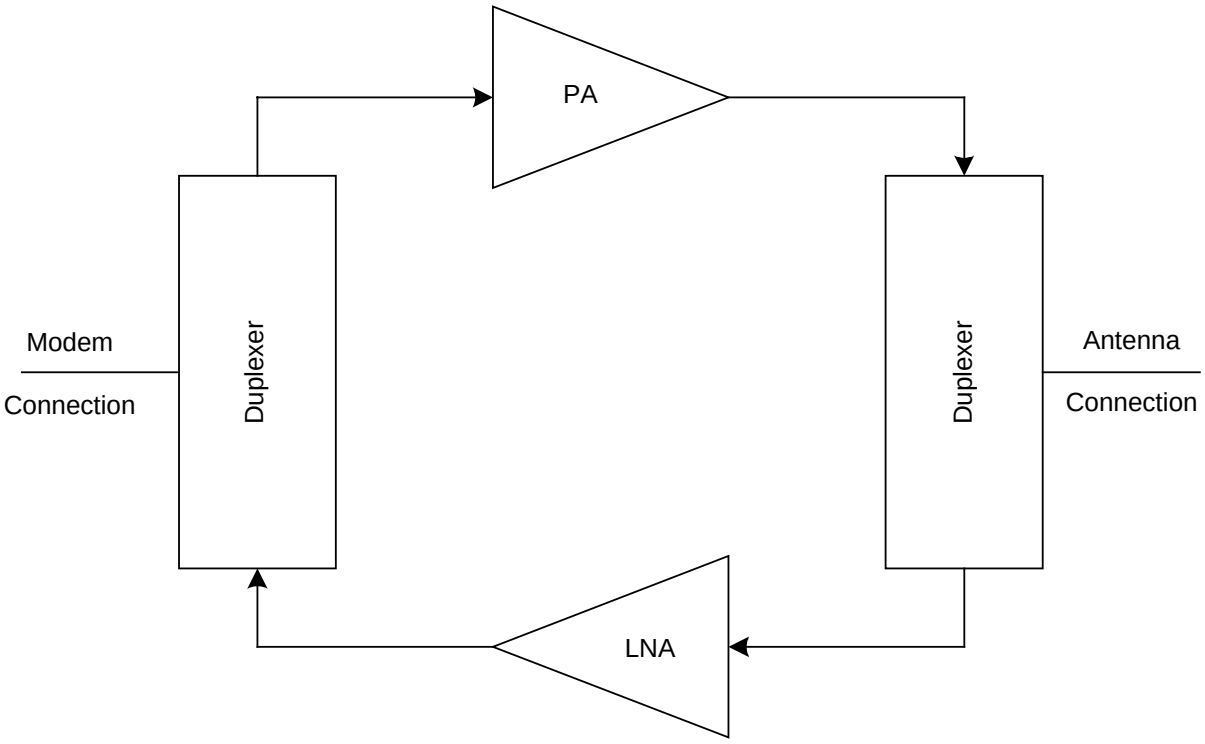
RECEIVER

Frequency Range:	824 - 849 MHz
Tunable Bands:	1
Local Oscillators:	Not Applicable
1st IF:	Not Applicable
2nd IF:	Not Applicable
Bandwidth:	Not Applicable
Type of modulation:	Not Applicable
Operator Selection of Operating Frequency:	Software controlled

THEORY OF OPERATION

The E.U.T. connects to the FCC approved "Spider" CDPD modem; (FCC ID: MIVWG9501A), to boost the Class III 0.6 watt modem power level to a 4 watt Class I output level. The booster uses duplexers at the input and output to split the Tx and Rx paths. The Tx path has three stages: Electronic Attenuator, PA Driver and PA. The Rx path has four stages: Preamp, SAW Filter, LNA and Electronic Attenuator.

BLOCK DIAGRAM



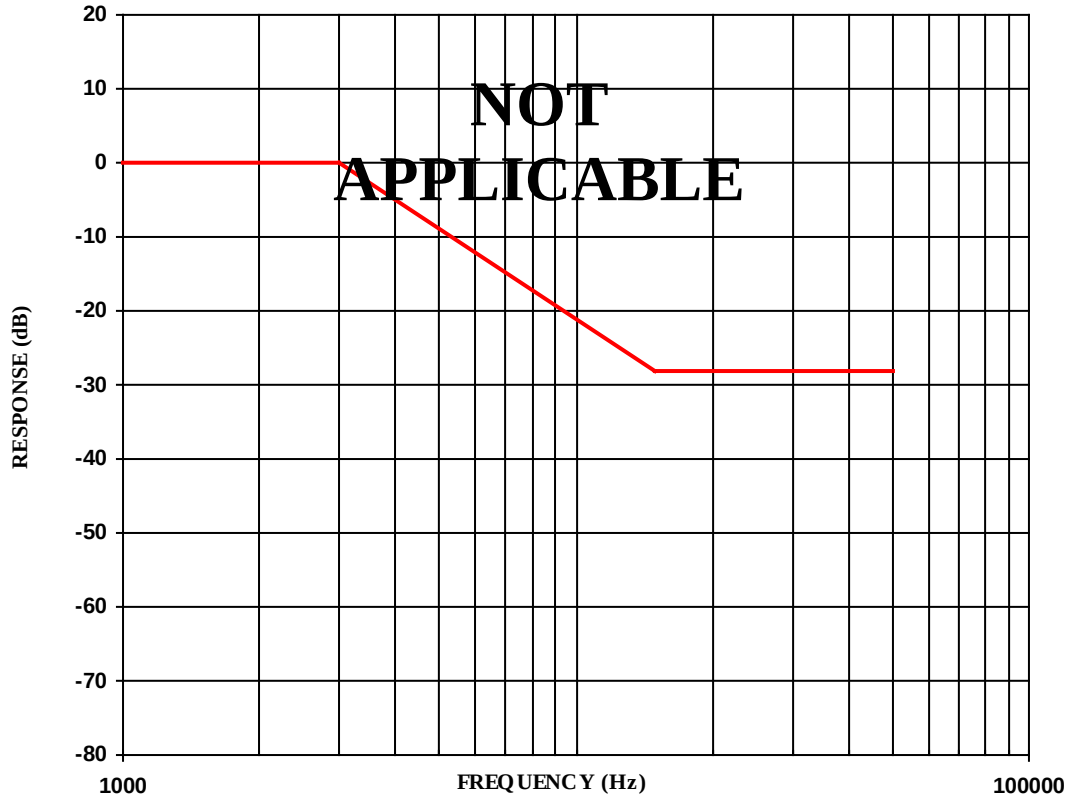
NAME OF TEST: RF Power Output	**PARA.NO.: 2.985**
TESTED BY: Tom Tidwell	**DATE: June 4, 1998**

TEST RESULTS: Complies.

MEASUREMENT DATA:

Channel	Input Level (dBm)	Output Power (dBm)	Rated Power (dBm)	Measured/Rated (dB)
383	N/A	+7.2	+7.8	-0.6
383	N/A	+36.5	+36.0	+0.5

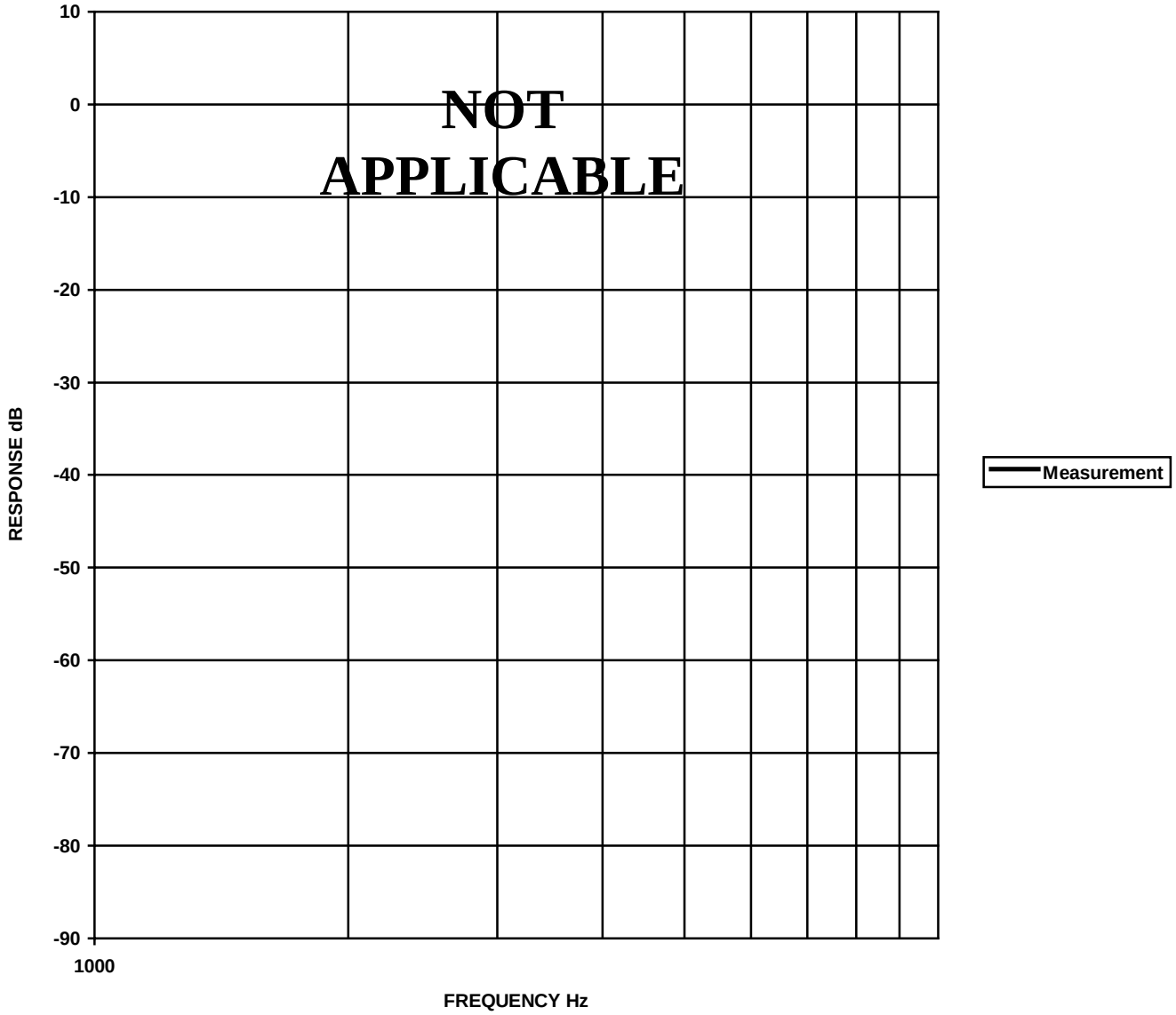
NAME OF TEST: Audio Frequency Response	**PARA.NO.: 2.987(a)**



AUDIO FREQUENCY RESPONSE

Frequency	Response(dB)		Frequency	Response(dB)
1000			8000	
1500			9000	
2000			10000	
2500			11000	
3000			12000	
3500			13000	
4000			14000	
4500			15000	
5000			20000	
5500			30000	
6000			40000	
7000			50000	

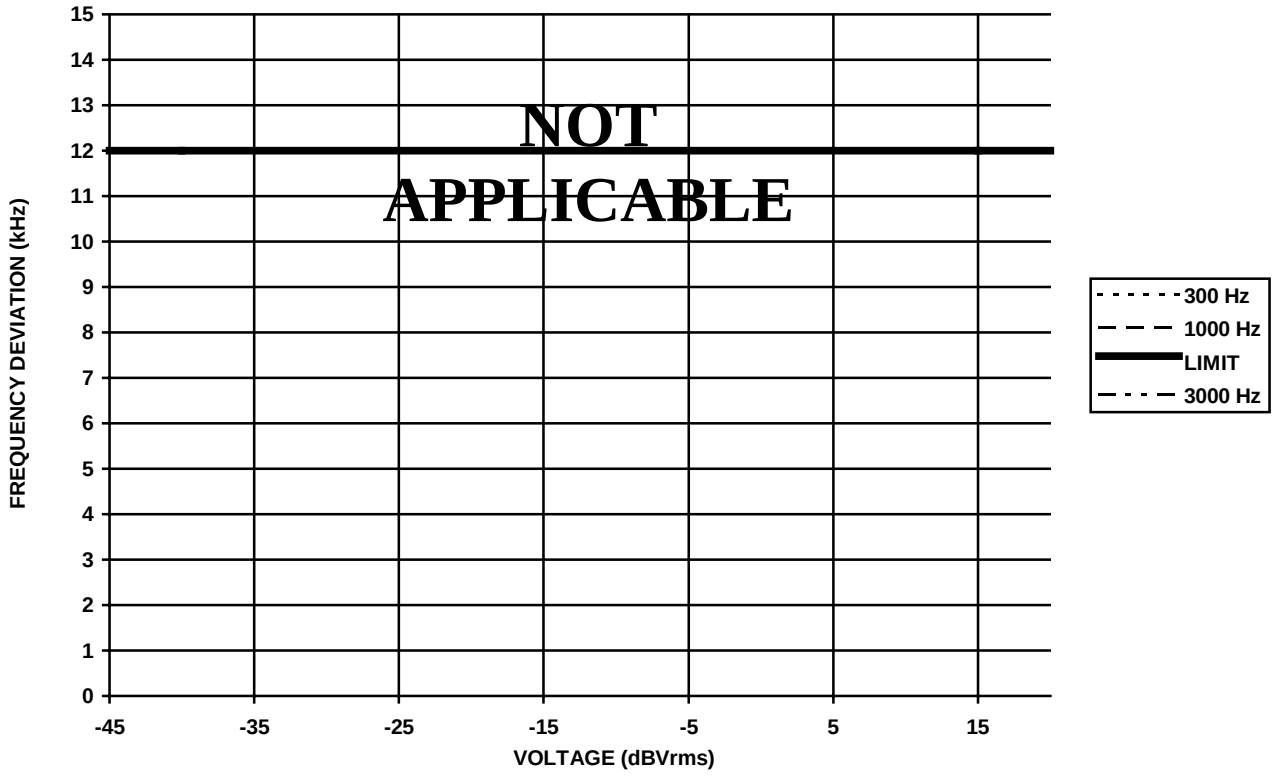
NAME OF TEST: Audio Low-Pass Filter Frequency Response	PARA.NO.: 2.987(a)



AUDIO LOW PASS FILTER RESPONSE

Frequency	1k	3 k	3.5 k	4 k	4.5 k	5 k	5.5 k	6 k	7 k	8 k	9 k	10 k

NAME OF TEST: Modulation Limiting	PARA.NO.: 2.987(b)



MODULATION LIMITING

SAT DEVIATION:
WB DATA DEVIATION:

NAME OF TEST: Occupied Bandwidth (voice)	**PARA.NO.: 2.917(c)**
TESTED BY:	**DATE:**

TEST RESULTS: Complies.

MEASUREMENT DATA: See attached graphs.

NAME OF TEST: Occupied Bandwidth(voice + SAT)	**PARA.NO.: 2.917(c)**
TESTED BY:	**DATE:**

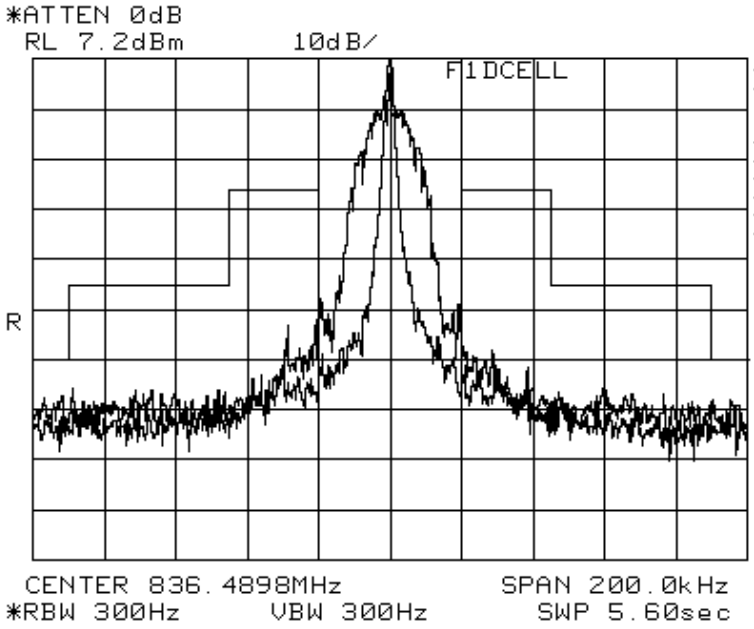
TEST RESULTS: Complies.

TEST DATA: See attached graphs.

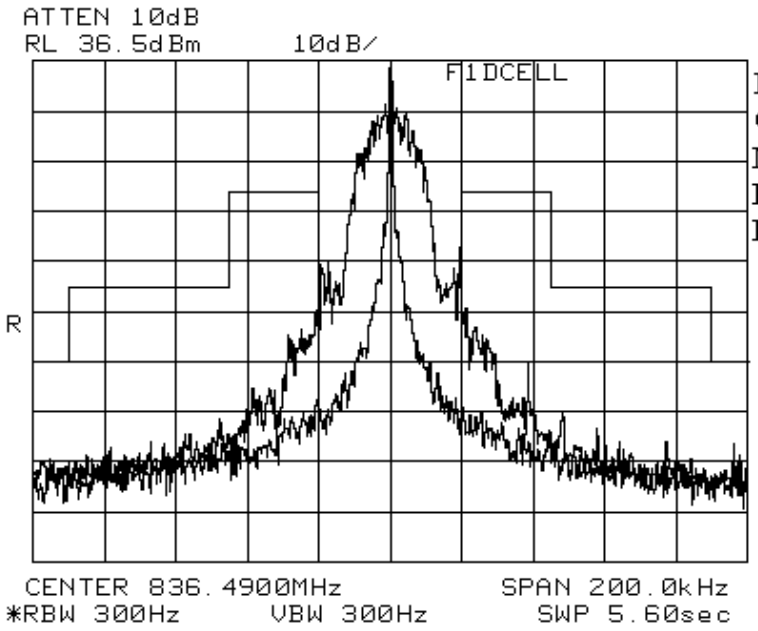
NAME OF TEST: Occupied Bandwidth(CDPD)	**PARA.NO.: 2.917(d)**
TESTED BY: Tom Tidwell	**DATE: June 4, 1998**

TEST RESULTS: Complies.

TEST DATA: See attached graphs.



PROJECT NO.: 8R00203
OCCUPIED BANDWIDTH
MODULATION: CDPD
DATA RATE: 19,200 bps
POWER OUTPUT: 5 mW



PROJECT NO.:8R00203
OCCUPIED BANDWIDTH
MODULATION: CDPD
DATA RATE: 19,200 bps
POWER OUTPUT: 4W

NAME OF TEST: Occupied Bandwidth(CDMA)	**PARA.NO.: 2.917(e)**
TESTED BY:	**DATE:**

TEST RESULTS: Complies.

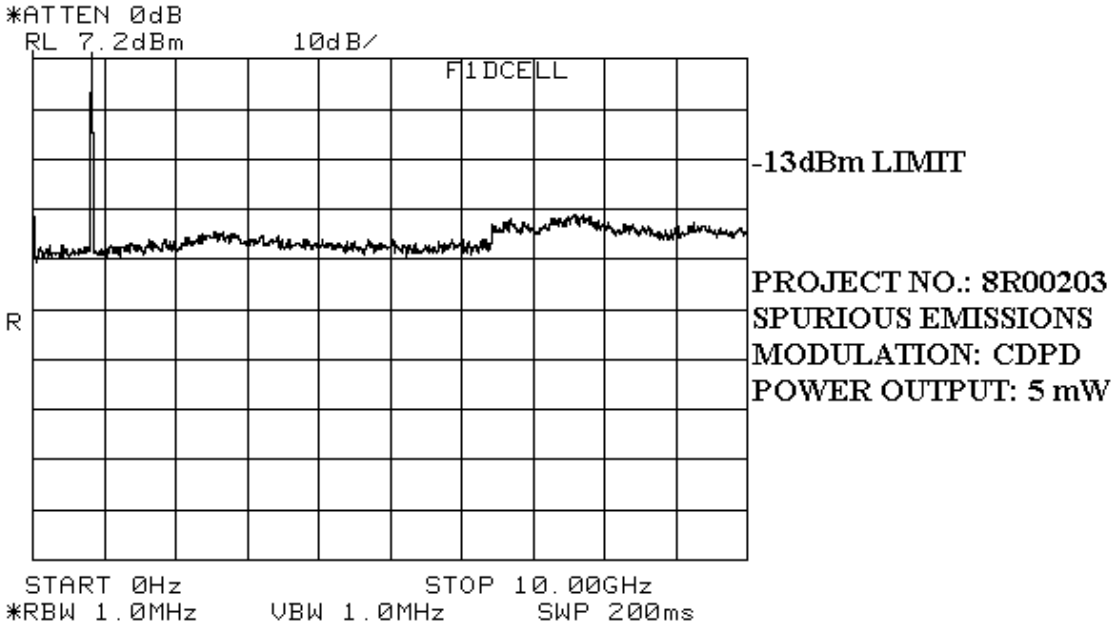
TEST DATA: See attached graphs.

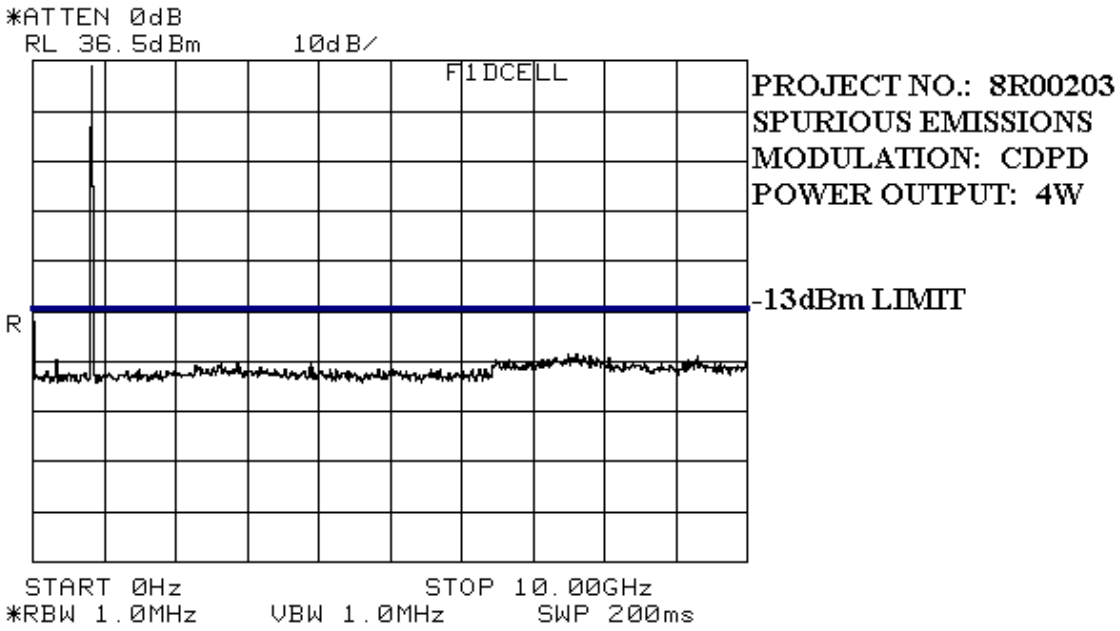
NAME OF TEST: Spurious Emissions @ Antenna Terminals	**PARA.NO.: 2.917(e)**
TESTED BY: Tom Tidwell	**DATE: June 4, 1998**

TEST RESULTS: Complies.

TEST DATA:

NAME OF TEST	WORST-CASE SPURIOUS LEVEL(dBm)
0 to 10 GHz spurious	-21
3 - signal intermodulation	Not Applicable


*ATTEN 0dB
RL 7.2dBm
10dB/
F1 DCELL
-13dBm LIMIT
PROJECT NO.: 8R00203
SPURIOUS EMISSIONS
MODULATION: CDPD
POWER OUTPUT: 5 mW
R
START 0Hz
STOP 10.00GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 200ms


*ATTEN 0dB
RL 36.5dBm
10dB/
F1 DCELL
PROJECT NO.: 8R00203
SPURIOUS EMISSIONS
MODULATION: CDPD
POWER OUTPUT: 4W
-13dBm LIMIT
R
START 0Hz
STOP 10.00GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 200ms

NAME OF TEST: Field Strength of Spurious	**PARA.NO.: 2.917(e)**
TESTED BY: Tom Tidwell	**DATE: June 4, 1998**

TEST RESULTS: Complies. The maximum field strength is 75.8 dBµV/m @ 3m.

TEST DATA: See attached tables.

Test Data - Radiated Emissions

Test Distance (meters) : 3		Range: A Tower		Receiver: Other		RBW(kHz): As Per Table		Detector: As Per Table			
			E.U.T. Model No.: Spider B3			Date: 06/04/98		Tested By: Tom Tidwell			
Freq. (MHz)	Ant. *	Pol. (V/H)	BW & Det.**	Table (deg.)	RCVD Signal (dBµV/m)	Ant. Factor (dB)**	Amp. Gain (dB)***	Dist. Corr. (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1673.0	Hrn2	V	5		32.3	29.8			62.1	82.2	20.1
1673.0	Hrn2	H	5		33.4	29.8			63.2	82.2	19.0
2510.0	Hrn2	V	5		42.6	33.2			75.8	82.2	6.4
2510.0	Hrn2	H	5		41.9	33.2			75.1	82.2	7.1
3346.0	Hrn2	V	5		66.0	39.3	-45.3		60.0	82.2	22.2
3346.0	Hrn2	H	5		65.1	39.3	-45.3		59.1	82.2	23.1
4182.0	Hrn2	V	5		62.4	39.1	-45.2		56.3	82.2	25.9
4182.0	Hrn2	H	5		60.0	39.1	-45.2		53.9	82.2	28.3

Notes:
* B/C = biconical, B/L biconilog, L/P = log-periodic, H = horn, D/P = dipole
Re-measured using dipole antenna ( ) denotes failing emission level.
(1) 120 kHz, Q-Peak, (2) 10 kHz, Peak, (3) 100 kHz, 300 kHz VBW Peak, (4) 300 kHz RBW, 1 MHz VBW Peak, (5) 1 MHz RBW, 1 MHz VBW Peak, (6) 1 MHz RBW, 10 Hz VBW Peak, (7) 3 MHz RBW, 3 MHz VBW Peak

Radiated Photographs - Worst Case

FRONT VIEW

NAME OF TEST: Frequency Stability	**PARA.NO.: 22.355**

MEASUREMENT DATA: See attached tables.

Standard test frequency: _____ MHz

Standard test voltage: _____Vdc

NOT APPLICABLE

ANNEX A

TEST METHODOLOGIES

NAME OF TEST:	**RF Power Output**	**PARA.NO.: 2.985**

TEST CONDITIONS: Standard Temperature & Humidity
Standard Test Voltage

MINIMUM STANDARD**:** Para. No. 22.913(a). The maximum effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

METHOD OF MEASUREMENT:

Detachable Antenna:
The peak power at antenna terminals is measured using an in-line peak power meter. Power output is measured with multiple carriers when applicable and the mean power output is measured.

Integral Antenna:
If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts
E = the maximum measured field strength in V/m
R = the measurement range (3 meters)
G = the numeric gain of the transmit antenna in relation to an isotropic radiator

NAME OF TEST: Audio Frequency Response	**PARA.NO.: 2.987(a)**

TEST CONDITIONS: Standard Temperature & Humidity
Standard Test Voltage

MINIMUM STANDARD: Signals applied to the modulator from the modulation limiter must be attenuated as a function of frequency as specified below.

(i) In the frequency range 3 to 15 kHz, signals must be attenuated by at least 40 log (f/3) dB, where f is the frequency of the signal in kHz.
(ii) In the frequency range above 15 kHz, signals must be attenuated by at least 28 dB

METHOD OF MEASUREMENT:

A 1 kHz audio signal is injected into the transceiver Tx audio port. The radio test set de-emphasis is turned on. The transceiver is keyed and the frequency deviation is monitored. The audio input level is adjusted until a peak deviation of 2.9 kHz is observed. This audio input level is maintained while the audio frequency is varied from 3 kHz to 50 kHz. The deviation output is measured and referenced to the deviation output at 1000 Hz (2.9 kHz).

NAME OF TEST: Modulation Limiting	**PARA.NO.: 2.987(b)**

TEST CONDITIONS: Standard Temperature & Humidity
Standard Test Voltage

MINIMUM STANDARD: 22.915

The levels of the modulating signals must be set to the values specified below and must be maintained within ±10% of these values.

Voice: ±12 kHz
SAT: ±2 kHz
Wideband Data: ±8 kHz

METHOD OF MEASUREMENT:

Voice: A 1 kHz audio tone is injected at levels between -45 and +20 dBVrms. The peak deviation is noted. This is repeated with a 300 Hz tone and a 3 kHz tone.

SAT: A SAT tone is generated by the base station and the peak deviation is measured.

Wideband Data: Wideband data is generated by the base station and the peak deviation is measured.

NAME OF TEST: Occupied Bandwidth (Voice & SAT)	**PARA.NO.: 2.989**

TEST CONDITIONS: Standard Temperature & Humidity
Standard Test Voltage

MINIMUM STANDARD: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(i) On any frequency removed from the carrier frequency by more than 12 kHz but not more than 20 kHz:

at least 117 log (f_d/12)

(ii) On any frequency removed from the carrier frequency by more than 20 kHz, up to the first multiple of the carrier frequency:

at least 100 log (f_d/11) dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

METHOD OF MEASUREMENT:

Spectrum analyzer settings:

RBW: 300 Hz
VBW: ≥ RBW
Span: 100 kHz
Sweep: Auto
Mask: CELLF3E

Input signal characteristics (F3E/F3D):

AF1 frequency: 2.5 kHz
AF1 level: 16 dB above the level sufficient to produce ±12 kHz deviation with a 1 kHz tone.
SAT: 6000 Hz SAT generated by the base station>
SAT level: sufficient to produce ±2 kHz deviation.

NAME OF TEST: Occupied Bandwidth (WB Data)	**PARA.NO.: 2.989**

TEST CONDITIONS: Standard Temperature & Humidity
Standard Test Voltage

MINIMUM STANDARD: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

(2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

(3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

METHOD OF MEASUREMENT:

Spectrum analyzer settings:
RBW: 300 Hz
VBW: ≥ RBW
Span: 200 kHz
Sweep: Auto
Mask: CELLF1D

Input signal characteristics:
RF level: Maximum recommended by manufacturer
AF1 frequency: 10 kHz, random bit sequence
AF1 level: sufficient to produce 8 kHz deviation

NAME OF TEST: Spurious Emission at Antenna Terminals	**PARA.NO.: 2.991**

TEST CONDITIONS: Standard Temperature & Humidity
Standard Test Voltage

MINIMUM STANDARD: Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least 43 + 10 log P. This is equivalent to -13 dBm absolute power.

METHOD OF MEASUREMENT:

Spectrum analyzer settings:
RBW: 30 kHz
VBW: ≥ RBW
Start Frequency: 0 MHz
Stop Frequency: 10 GHz
Sweep: Auto

NAME OF TEST: Field Strength of Spurious Radiation	**PARA.NO.: 2.993**

TEST CONDITIONS: Outdoor Range
Standard Test Voltage

MINIMUM STANDARD: Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least 43 + 10 log P. This is equivalent to -13 dBm absolute power.

CALCULATION OF FIELD STRENGTH LIMIT

An example of attenuation requirement of 43 + 10 Log P is equivalent to -13 dBm (5×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$GP/4\pi R^2 = E^2/120\pi$

For emissions ≤ 1 GHz:

G = 1.64 (Dipole Gain)
$P = 10^{-5}$ Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

$$E = \frac{\sqrt{30GP}}{R}$$

$$\mathrm{E} = \frac{\sqrt{30 \times 1.64 \times 5 \times 10^{-5}}}{3} = 0.016533 \text{ V / m} = 84.4 \text{ dB}\mu\text{V / m}$$

For emissions > 1 GHz:

G = 1 (Isotropic Gain)
$P = 1 \times 10^{-5}$ Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

$$E = 84.4 - 20Log\sqrt{1.64} = 82.3dB\mu V \ / \ m@3m$$

NAME OF TEST: Frequency Stability	**PARA.NO.: 2.995**

TEST CONDITIONS: As per measurement data.

MINIMUM STANDARD: Para. No. 22.355. The transmitter carrier frequency shall remain within the tolerances given in Table C-1.

Freq. Range (MHz)	**Base, fixed**	**Mobile > 3 W**	**Mobile ≤ 3 W**
821 to 896	1.5	2.5	2.5

Table C-1

METHOD OF MEASUREMENT:

FREQUENCY STABILITY WITH VOLTAGE VARIATION
The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. With the voltage input to the E.U.T. set to 85% S.T.V., the frequency is measured in 30 second intervals for a period of 5 minutes. This procedure is repeated at 100% S.T.V. and 115% S.T.V.

FREQUENCY STABILITY WITH TEMPERATURE VARIATION
The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

ANNEX B
TEST EQUIPMENT

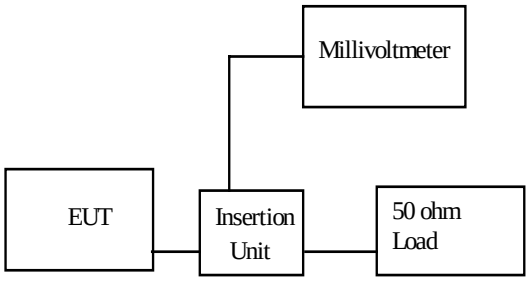
RADIO TEST EQUIPMENT LIST

CAL CYCLE	EQUIPMENT	MANUFACTURER	MODEL	SERIAL	LAST CAL.	NEXT CAL.	
1 Year	Spectrum Analyzer	Hewlett Packard	8565E	865366	Feb. 27/98	Feb. 27/99	
	Power Supply	Astron	VS-50M	8405071	NCR	NCR	
1 Year	Attenuator	Narda	768-20	9507	July 23/97	July 23/98	
1 Year	Attenuator	Narda	765-20	9510	July 23/97	July 23/98	
1 Year	Attenuator	Narda	768-10	9704	Oct. 1/97	Oct. 1/98	
1 Year	Attenuator	Narda	768-10	9709	Oct. 1/97	Oct. 1/98	
1 Year	RF Millivoltmeter	Rohde & Schwarz	URV5	FA000420	July 23/97	July 23/98	
1 Year	Insertion Unit	Rohde & Schwarz	URV5-Z4	FA000905	July 23/97	July 23/98	
1 Year	Power Sensor	Rohde & Schwarz	URV5-Z5	FA000419	July 23/97	July 23/98	
1 Year	Receiver	Rohde & Schwarz	ESVP	892661/014	Mar. 31/98	Mar. 31/99	
2 Year	Horn Antenna	EMCO #2	3115	4336	Oct. 30/97	Oct. 30/99	
1 Year	Low Noise Amplifier	Avantek	AWT-8035	1005	Oct. 24/97	Oct. 24/98	

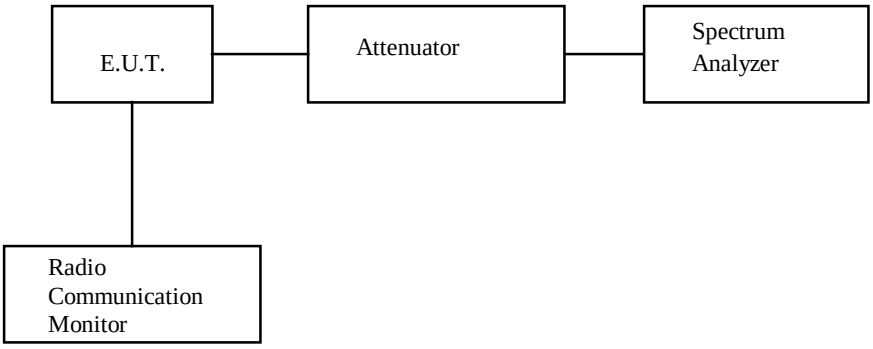
NA: Not Applicable
NCR: No Cal Required

ANNEX C
BLOCK DIAGRAMS

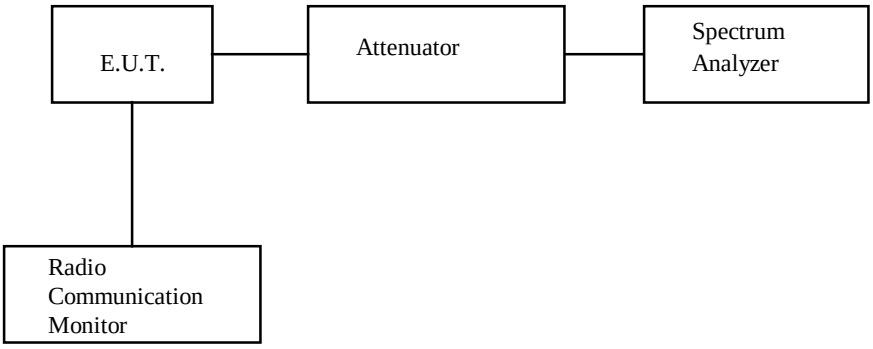
PARA. NO. 2.985 RF POWER OUTPUT



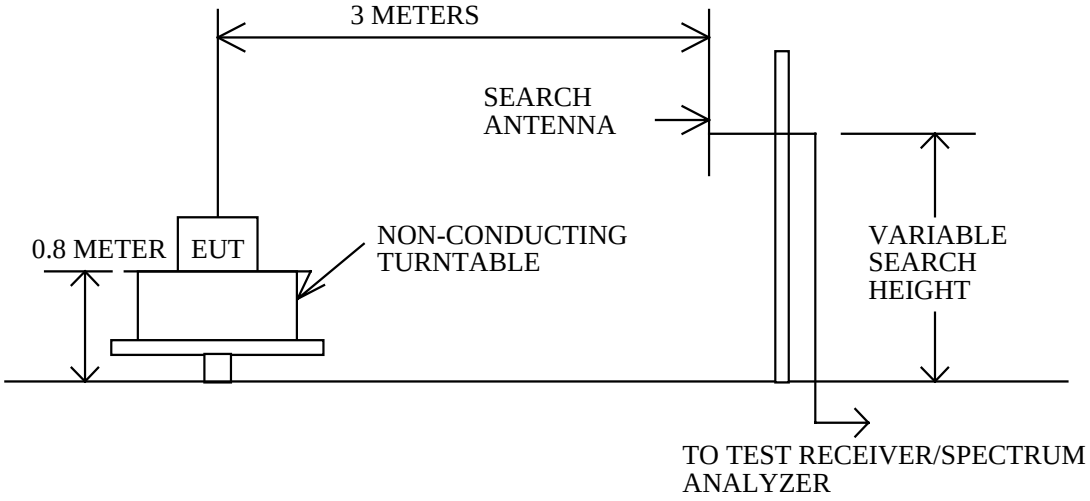
PARA. NO. 2.989 OCCUPIED BANDWIDTH



PARA. NO. 2.991 SPURIOUS EMISSIONS AT ANTENNA TERMINALS



PARA. NO. 2.993 FIELD STRENGTH OF SPURIOUS RADIATION



PARA. NO. 2.995 FREQUENCY STABILITY